CHAPTER I
INTRODUCTION

1.1 Background

Nowadays, animation technology changes rapidly, and researchers are competing to research in this field to make computing animation easier, faster, and sophisticated, especially in 3D modelling animation. Many studios are turning to use Motion Capture (MOCAP) technology, a method for recording the motions directly from actors and converting them into mathematical data (Menache, 2000). MOCAP is applied in 3D models animation for military, entertainment, sports, medical applications, robots, virtual reality, analyzing human behaviour (Human Behavior) and others (Moeslund and Granum, 2001). MOCAP technology is aimed to capture the position, motion, and orientation of an object in real space and then record data into the digital world (Shafaei and Little, 2016).

As time goes by, MOCAP technology increased, and new technologies emerged called markerless MOCAP. Markerless MOCAP is simpler and cheaper than standard MOCAP technology, which uses a depth sensor camera such as Microsoft Kinect. The depth sensor camera is used as a control console for X-BOX game platforms. Microsoft Kinect's price themselves are not very expensive, from one to two million rupiahs. (Djalle, 2018).

Recently, thanks to the rapid diffusion of the low-cost Kinect device by Microsoft Corp., the researchers in ergonomics have begun to introduce it as a possible alternative to the costly marker-based instrumentation. In 2012, two research groups tested the accuracy of the Kinect V1 sensor in the measurement of primary ergonomics purposes. The first contribution (Dutta, 2012) only focused on the assessment of the evaluation of the workspace, while the second one (Clark et al., 2012) also tested the sensor on 20 healthy subjects performing basic and simple slow activities (forward reach, lateral reach, single-leg standing).

The scientific literature also reports very recent contributions to the more in-depth assessment of the Kinect sensors in ergonomics. Several researchers exploited the MOCAP technologies to assess the ergonomic risk of performing manual manufacturing or assembly activities. Jayaram et al. (2006) first adopted inertial MOCAP to evaluate the RULA index for an operator performing tasks in a manufacturing shop floor. Puthenveetil and Daphalapurkar (2015) follow this research direction replacing the inertial MOCAP with active marker-based optical MOCAP technology. Concerning the ergonomic perspective, different authors adopted MOCAP technologies to ease the evaluation of ergonomic indices. Vignais et al. (2013) assess the RULA index analysing the different body part of the human operator through the inertial MOCAP. The adoption of markerless optical MOCAP represents a remarkable improvement in the ergonomic assessment. Plantard et al. (2016) integrate multiple depth cameras to increase the accuracy and the covered area of the monitored human motions with promising results and proposed the evaluation of the accuracy of the Kinect device by using a virtual mannequin and confirmed that the Kinect software can be a useful motion capture tool for ergonomic evaluation.

In ergonomics, the posture and motion of a worker are essential information for determining the risk of musculoskeletal injury in the workplace. In many assembly operations, there are repetitive motions, uncomfortable postures, and other ergonomic hazards. Ergonomic assessments contribute to increasing the productivity and performance of organizations by reducing the rate of work injuries and working to preventing them. Different methods and tools have been developed to assess exposure to risk factors for work-related musculoskeletal disorders (MSDs). They can be divided into three groups according to the measurement technique. They are the self-report, direct measurement and observational methods (Li and Buckle, 1999).

Self-report methods can take many various forms such as rating scales, questionnaires, checklists or interviews. However, they are not always reliable and could lead to biased interpretation. The direct method, which is to collect data directly from sensors attached to the worker's body, is challenging to implement in real work situations (Li and Buckle, 1999). Moreover, wearing these devices may cause discomfort and influence postural behaviour. Observational methods consist of directly observing the worker and the corresponding tasks, such as the OWAS (Ovako Working-posture Analysis System) method. The accuracy and validity of the results obtained by observational methods directly depend on the input information collected (Fagarasanu and Kumar, 2002).

Full-body motion capture data is frequently used in the manufacturing industry for various use cases such as process verification, visibility checks or buildability assessments. Besides this, more and more ergonomic assessments are carried out using digital human models (DHMs) to analyze assembly workplaces and worker postures virtually. DHM simulations provide reasonable estimations of overall workload in real-life tasks for ergonomics risk assessment. DHM saved many months and thousands of dollars in design and prototype testing, compared to their traditional methods (Fritzsche, 2010).

Using a virtual environment with an animated Digital Human Model (DHM), an ergonomics expert, can assess the overall process and come to the same conclusions as in the physical domain. This evaluation aims to answer the question of whether the Kinect as a standalone and the multi-sensor system can deliver assessable results for OWAS working posture assessments. Haggag et al. evaluated Kinect v1 for rapid upper limb assessment (RULA) using an automated assessment approach in 2013.

Using Kinect v1, literature presents many real-life application scenarios, case studies in the manufacturing industry for ergonomic assessments, object tracking and walk path assessments. Even though multiple publications are presenting Kinect as a possibility to be used in ergonomic assessments, none of them has evaluated it for specific working postures (Haggag et al, 2013). None of the research focused on the OWAS assessment through MOCAP technologies. They do not give practical insights on which motions are feasible and which are not using the Kinect skeletal tracker.

This final project presents an applicability evaluation of Kinect sensor's motion-capture performance to be used for ergonomics assessments. In particular, the Ovako Working-posture Analysis System (OWAS) is applied as a reference.

OWAS working postures are evaluated in the following if they can be carried out by using the presented markerless motion capture system. The intended goal is achieved, when the ergonomic expert comes to the same assessment results by visually inspecting all working postures of the animated DHM in the simulation scene.

1.2 Problem Formulation

Based on the background, the problem formulation of this final project discusses whether markerless MOCAP Kinect V1 can be applied in delivering assessable results for OWAS working posture assessment.

1.3 Research Scope and Limitations

The limitations of the problem in this final project are as follows:

1. The application captures human motion as a whole (full-body), not paying attention to details, such as finger motions, facial expressions, and small elements on the human body.
2. The final project is only at the evaluation stage of the OWAS posture. The simulation is carried out by an ergonomic expert to evaluate a workspace and worker.

1.4 Research Objectives

The objective of this final project is to evaluate the ability of markerless MOCAP Kinect V1 in delivering assessable results for OWAS working posture assessment.

1.5 Outline of The Report

CHAPTER I INTRODUCTION

Contains discussion of general issues raised in the study, discussing the background of MOCAP ergonomics reasons, formulating debates related to MOCAP, discussing challenges so that the discussion is more directed and the purpose of using and using the benefits of capture to overcome the problem. The MOCAP technique implemented in this study is markerless MOCAP, using Kinect as a sensor that produces motion obtained by data or a particular file format for MOCAP, this motion data is finally implemented in Blender and Kinovea applications.

CHAPTER II LITERATURE REVIEW

Contains the study of theories used in research. This chapter will discuss OWAS ergonomic assessment which is the main problems in this study, then an explanation of MOCAP as a solution to the problem, an explanation of Microsoft Kinect as a MOCAP media, Blender and Kinovea as applications used to analyze.

CHAPTER III RESEARCH METHODOLOGY

Contain steps to be carried out in research, starting from preliminary studies, problem identification, problem formulation, data collection, data processing, analysis, and closing.

CHAPTER IV RESULTS AND DISCUSSIONS

This chapter contains a description of the research and a discussion of the results of the research conducted. Start from gathering what data is used, an explanation by describing the flow as a whole. Then all the data obtained will be analyzed in this chapter.

CHAPTER V CONCLUSIONS

This chapter contains conclusions from all the research that has been done, suggestions or recommendations from the author for further research activities related to the topic discussion.

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